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Spectrum of Brain Changes in Alcohol Dependence Syndrome Patients by Magnetic Resonance Imaging

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ABSTRACT
Substance abuse is an enormous problem worldwide. The substance abuse and its direct and indirect complications have many medical, social and economic consequences. Alcohol consumption has became a major public health issue especially in developing countries. Alcohol consumption is widespread in India, 30% of Indian population consumes alcohol regularly and 11% are moderate to heavy drinkers. This is a hospital based, cross sectional case study conducted on all alcohol dependence syndrome patients attending outpatient and inpatient department admitted in hospital. In our study which comprised of 55 patients, most frequently observed MRI brain finding was cortical atrophy followed by cerebellar atrophy other findings include hepatic encephalopathy, non-specific T2 hyperintensities, least common findings being central pontine myelinosis and marchiafava bignami disease. 40% of the study subjects showed cortical atrophy.

INTRODUCTION

Substance abuse is an enormous problem worldwide. The substance abuse and its direct and indirect complications have many medical, social and economic consequences. Alcohol is socially and legally accepted substance of abuse. Because of its wide availability, aggressive marketing and relatively cheap price attracts the common man for pleasure seeking [1].

It became a major public health issue especially in developing countries. Currently rapid changes have occurred in alcohol use in India. The change includes early age of initiation of alcohol intake, excessive consumption of spirits to the point of intoxication and blackout, binge drinking and taking alcohol when they are alone to combat boredom. In India 95% of alcohol consumed in the form of spirit (exp. Whisky, rum, brandy, vodka), they have high alcohol content (40-47%). But in western societies they take more amounts of beer and wine, which have low alcohol content. These factors add to the risks encountered by the western population.

Alcoholism causes a multitude of social and health problems with negative impact on quality of life and secondary costs to society. Alcohol is one of the most commonly abused substances and it is the third leading cause of disease burden in developing countries worldwide. The overall prevalence of alcohol dependence among males aged ≥15 years was 3.8% and among females aged ≥15yrs was 0.4%[2].

Alcohol consumption is widespread in India, 30% of Indian population consumes alcohol regularly and 11% are moderate to heavy drinkers. The Disability-adjusted light years (DALY) is increased over time in India from 2000-2015[2].

Alcohol affects every part of the body, from hair to nail. The first and foremost organ which is influenced and damaged is the brain, especially frontal lobe. From head to toe alcohol greys the hair, accelerates the aging process and causes more wrinkles in face, it produces telangiectasias, gynaecomastia, ascites, malnutrition and its complications. In gastro intestinal tract it causes peptic ulcer, chronic liver diseases and pancreatitis. It affects respiratory diseases like aspiration pneumonia. It affects cardiovascular system like dilated cardiomyopathy, atrial fibrillation and increase proneness to develop myocardial infarction. Alcohol is one of the leading causes for cancers, especially oropharyngeal and gastrointestinal cancers[3].

Chronic ethanol intoxication may lead to loss of subcortical white matter, cerebral atrophy, Wernicke's encephalopathy, Marchiafava-Bignami disease, osmotic demyelination syndrome and basal ganglia changes seen in patients of hepatic encephalopathy [4].

Dementia due to frontal lobe atrophy is a common age-related problem in chronic alcoholics[5]. The findings of severe damage to the frontal cortex in alcoholics is consistent with clinical and neuroradiological study which suggest that frontal lobe may be more susceptible to alcohol-related brain damage and other cortical regions[6].

Moderate/heavy alcohol consumption in older people has been associated with reduced total brain volume, increased ventricle size[7]. Several studies have shown that abstinence can reverse much of the cognitive damage caused by heavy drinking[8].

Neuropathological studies conducted on the brains of deceased patients as well as findings derived from neuroimaging studies of the brains of living patients, point to increased susceptibility of frontal brain systems to alcoholism-related damage8. Neuropathological studies have also demonstrated substantial changes in different brain regions such as parts of cerebral cortex, basal forebrain, thalamus and hypothalamus[9].

As a preliminary neuroimaging choice, an immediate CT scan is recommended, in order to identify occult intra cranial abnormalities like acute parenchymal and chronic subdural haemorrhage, but other neuroparenchymal abnormalities like cerebral and cerebellar volume loss and white matter changes which cannot be made out on CT study can be better delineated on magnetic resonance imaging. The other disadvantages associated with CT study like radiation exposure and bony artefacts, near the inner table of the skull, is overcomed by magnetic resonance imaging.

MRI is the most sensitive imaging modality to identify various neuroimaging findings in chronic alcoholic patients. Alcohol-related encephalopathies can be life-threatening conditions, so the early diagnosis can significantly alter the prognosis of the afflicted patient[10].

MATERIALS AND METHODS

This is a hospital based, cross sectional case study conducted on all alcohol dependance syndrome patients attending outpatient department and inpatient admitted in hospital. A total of 55 patients in the age group of 18-50 yrs, fullfilling the inclusion criteria were included in the study.

Inclusion criteria

- Patient willing to give informed consent.
- Patients aged between 18-50 yrs who have been diagnosed with alcohol dependence syndrome according to the International Classification of Disease criteria (ICD-10).

Exclusion criteria

- Patient not willing to give informed consent.
- Patient with a history of major medical and neurological illness.
- Patient with a history of major psychiatric illness.

- Patient with a history of seizure disorder unrelated to alcohol consumption.
- Patient with contraindication for MRI scans such as Pacemakers, metallic implants or metallic foreign body.
- Patient with a history of other substance abuse (except nicotine).

The Study group consisted of 55 patients, who fulfilled the alcohol dependence syndrome criteria according to the International Classification of Disease criteria (ICD-10). Alcohol use disorder identification test scale was applied and individual with alcohol dependence score of >15 (for men) were considered for study.

Hemodynamically stable patients, referred to the department of Radio diagnosis BMCRI, for imaging studies were included in the study after duly taking an informed consent. Details of the study were collected and documented as per the proforma attached. All patients were screened before entry into the MRI scanning room for ferromagnetic objects, cardiac pacemakers, aneurysm clips etc. Patients were examined in the supine position on the MRI machine after proper positioning and immobilization of the head was obtained. The head coil was used for the scan. Initial topogram of the head was obtained and sequences were planned according to the MRI brain (plain without contrast) protocol.

RESULTS AND DISCUSSIONS

The study group consisted of male patients with the age of the patients ranging from 18 yrs to 50 years. The maximum number of patients were seen in the age group of 41-50 years (49%), 36.3% were in age group of 31-40 years and 14.5% were in age group 20-30 years. The minimum age of patient was 26years and maximum age was of 50 years.

Out of 55 study subjects 12.7% had a history of alcohol intake less than 10 years (Category 1). 54.6% had history of alcohol intake of 10-19 years (Category 2), rest 32.7% had history of alcohol intake of greater than 20 yrs (Category 3).

All 55 cases in our study were alcohol dependence syndrome patients with AUDIT score >15 for men. Few of the study subjects were asymptomatic and rest symptomatic subjects were mainly categorized based on their clinical presentation into 5 groups i.e., those presenting with headache and vomiting, tremors, seizures, altered sensorium and irritability and confusion.

Asymptomatic subjects in our group were 16/55 (29%). The most frequently occurring symptom was headache and vomiting 23/55 (41.8%). The other frequently occurring symptoms were tremors 17/55 (30%), altered sensorium 8/55 (14.5%), irritability and confusion 6/55(10.9%) and seizures 5/55 (9%).

Second most common finding in our study group was cerebellar atrophy seen in 12/55(21.8%) occurring as a isolated finding in 3/55(5.4%) and associated with cerebral atrophy it is seen in 9/55(16.3%). Vermis and the anterior portion of cerebellum are predominantly involved associated with corresponding dilation of IV ventricle. This finding was consistent to the single case study done by Ji Hoon[11] in which alcohol induced cerebellar degeneration predominantly involved anterior-superior vermis and anterior cerebellum in early stage.

Cala[12] conducted a cross-sectional study on correlation between cerebellar degeneration and heavy drinkers which showed higher proportion of cerebellar atrophy cases (19 cases out of 26 (70%)).

One research conducted by Zahr[13] states that pre-velance of cerebellar atrophy in alcohol dependence syndrome patients range from 0.4-4.2%.

In our study imaging findings of hepatic encephalopathy were seen in 3/55 (5.4%). These hepatic encephalopathy changes were seen secondary to cirrhosis induced by chronic alcohol intake. Symmetric T1 hyperintensities were noted in bilateral basal ganglia (Particularly the globus pallidus). T1 hyperintensities are mainly due to manganese deposition. One research conducted by Zahr[13] states that prevelance of hepatic encephalopathy in alcohol dependence syndrome patients range from 3-16%.

Geissler *et al.* conducted a cross-sectional study on cerebral abnormalities in 51 patients with cirrhosis, which showed bright basal ganglia in 37 patients out of 51 patients 14. No other changes like cortical hyper intensities and cortical atrophy were seen in our study as seen in study conducted by Geissler *et al.*

Central pontine myelinosis is a rare entity which occurs following rapid correction of hyponatremia. In our study imaging findings of osmotic demyelination were seen in only one patient (1/55(1.8%). There was T2 hyperintensity noted in central pons with corresponding area showing diffusion restriction. This finding was consistent with case study finding done by Kimberly *et al*. which showed diffusion restriction as the earliest finding followed by the presence of T2 hyperintensity changes[15].

According to retrospective study done by mandrekar *et al*. in 24 patients of osmotic demyelination, 18/25(75%) patients had history of alcoholism[16].

MBD is a very rare disorder associated with chronic alcoholism that results in progressive demyelination and necrosis of the corpus callosum. In our study imaging features of marchiava bignami disease were seen in only one patient (1/55 (1.8%). Areas of T2/Flair hyper intensities are noted in body and splenium region of corpus callosum with diffusion restriction

Table 1: Age distribution of subjects in the study

Age	Count	%
21-30 years	8	14.5%
31-40 years	21	36.3%
41 -50 years	26	49.2%

Table 2: Clinical presentation distribution among study subjects:

Clinical Features	Count	%
Seizures	5	9%
Altered sensorium	6	10.9%
Irritability/confusion	8	14.5%
Asymptomatic	16	29%
Tremors	17	30.9%
Head ache/vomiting	23	41.8%

Table 3: Years of drinking distribution among subjects

Years of Drinking	Count	%
0-9 years	7	12.7%
10-19 years	30	54.6%
≥20 years	18	32.7%

(0-9 years = Category 1, 10-19 years = Category 2, = 20 years = Category 3)

Table 4: Various MRI finding distribution among subjects

MRI Findings	Count	%
Central pontine myelinosis	1	1.8%
Marchiafava Bignami disease	1	1.8%
Hepatic encephalopathy	3	5.4%
Nonspecific findings	8	14.5%
Cerebellar atrophy	12	21.8%
Normal MRI brain	20	36%
Cortical atrophy	22	40%

seen in the corresponding areas on DWI images. These findings were similar to the findings seen in case study done by kumar *et al*. which showed similar findings of high signal intensity in T2WI in the central portion of genu, body and splenium of corpus callosum. One research conducted by Zahr *et al*. states that pre-velance of Marchiafava bignami disease in alcohol dependence syndrome patients is <1%.

CONCLUSION

MRI was able to detect brain changes in alcohol dependence syndrome patients like cerebral atrophy (40%), cerebellar atrophy (21.8%), hepatic encephalopathy (5.4%), central pontine myelinosis (1.8%) and marchiafava bignami disease (1.8%), non-specific T2 hyperintensities (14.5%). Few of the study subjects showed normal MRI brain study (36%).

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